SEMESTER EXAMINATION, DECEMBER, 2025

Course Name: - B.Tech (CSE-AIFM) **Semester:- Third**

Paper Name: - Mathematical Foundation for AI **Paper Code:- NAM-301**

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer. Max Marks-70

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries 3 **mark. All questions are compulsory**.
- Section B- Answer any **5 out of 7** given questions. Each question carries **7 marks**.
- Section C- Answer any **2 out of 3** given questions. Each question carries **10 marks**.

Section – A

Multiple Choice Questions

1. Answer all the following questions. **5x3 =15**

1. If $cov\ (x, y) = 40, var(x) = 120$ and $var(y) = 30$, then coefficient of correlation between x and y is
   a) 0.62
   b) 0.66
   c) 1.20
   d) -0.360

2. The geometric mean between regression coefficients is the coefficient of correlation r then
   a) $\sqrt{b_{xy}b_{yx}} \geq 1$
   b) $\sqrt{b_{xy}b_{yx}} \leq 1$
   c) $\sqrt{b_{xy}b_{yx}} = 1$
   d) None of these

3. Partial correlation Coefficient $r_{23.1}$ is strictly negative, if
   a) $r^2{}_{23} > r_{12}r_{13}$
   b) $r^2{}_{32} < r_{12}r_{13}$
   c) $r_{23} < r_{12}r_{13}$
   d) $r_{32} > r_{12}r_{13}$

4. A matrix A is said to be nilpotent if
   a) $A^2 = 0$
   b) $A^2 = I$
   c) $A^2 = O$
   d) $A^2 = A$

5. Let V be the vector space of $m \times n$ matrices over a field k, then dimension of V is:
   a) n
   b) m
   c) mn
   d) $m - n$

Section – B

Short Answer Questions

2. Answer any five of the following questions. **5x7=35**

i) Define moments and moments about the mean and write the relation between moments about the mean and moments about any number.

ii) If $T: R^3 \to R^2$ be a linear transformation defined by $T(x, y, z, t) = (x + 2y, x - y)$. Find the range space of T.

iii) Let V be the set of all pairs (x, y) of real numbers, and let F be the field of real numbers define:

$$(x, y) + (x_1, y_1) = (x + x_1, y + y_1)$$
$$c(x, y) = (cx, y)$$

Is V, with these operations, a vector space over the field of real numbers?

iv) Find the first four moments for the following individual series:

x	1	4	5	12	15

v) Show that the following set of vectors form the basis for R^3:

a) $A = \{(1,0,-1), (1,2,2), (0,-3,2)\}$

b) $B = \{(1,1,0), (1,-1,0), (0,0,1)\}$

vi) The first four moments of a distribution, about the value 3 are 2, 10, 40 and 218. Calculate the first four moments about the origin.

vii) Calculate the correlation coefficient between the following data:

x	7	11	13	15	21
y	12	20	25	33	35

Section – C

Descriptive Questions

3. Answer any two of the following question. **2x10=20**

i) Verify, the following transformations are linear or not:

a) $T: R^3 \to R; T(a, b, c) = 2a - 3b + 4c$

b) $T: R \to R^3; T(a) = (a, 2a, 3a)$

c) $T: R^2 \to R^3; T(a, b) = (a + 1, 2b, a + b)$

ii) Calculate the first four moments of the following distribution about the origin and hence find $ß_1$ and $ß_2$

x	0	1	2	3	4	5	6	7	8
f	1	8	28	56	70	56	28	8	1

iii) Find the regression line of y on x for the following the correlation coefficient between the following data:

x	1	3	4	6	8	9	11	14
y	1	2	4	4	5	7	8	9

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